NASA Project Estimating vs Construction Estimating – are we that different?

August 14th, 2014

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NASA Armstrong Flight Research Center

Introduction & Background

- Can you use your training and skills at work and adapt them to real life events?
- On February 18th, 2013 (President's Day) I received a call from the fire department stating "my home was on fire", while I was on vacation with my wife in Mexico.

- Does NASA Project Estimating differ from Construction Cost Estimating?
- Question – are we that different?








Cross-Section Look at Cost Estimation

- **Where do you start?**
- NASA and GAO both have a Step 12 Step Process.

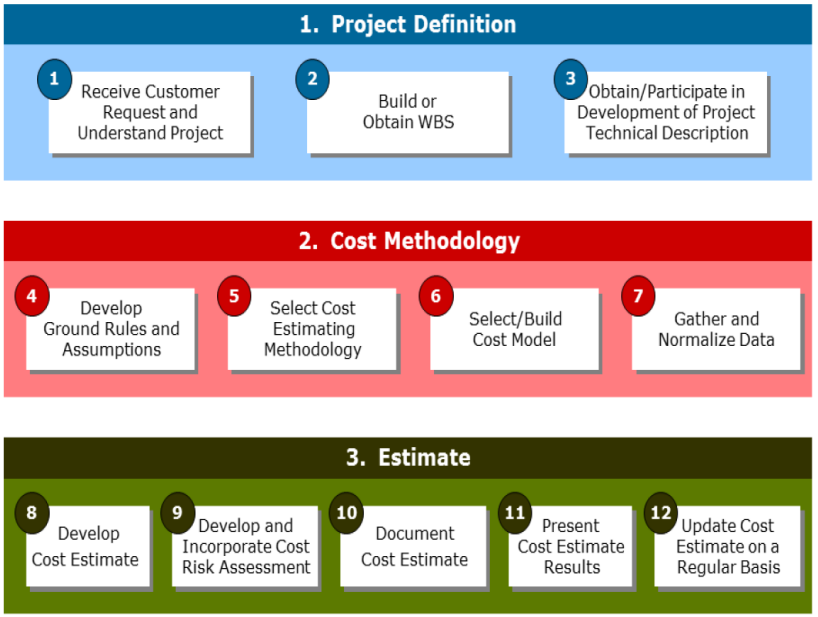


Figure 1. The Cost Estimating Process

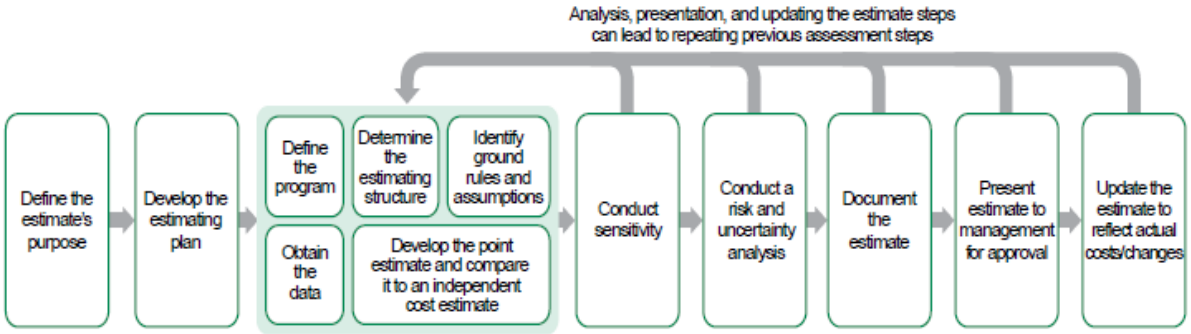
Figure 1: The Cost Estimating Process

Initiation and research
Your audience, what you are estimating, and why you are estimating it are of the utmost importance

Assessment
Cost assessment steps are iterative and can be accomplished in varying order or concurrently

Analysis
The confidence in the point or range of the estimate is crucial to the decision maker

Documentation and presentation make or break a cost estimating decision outcome



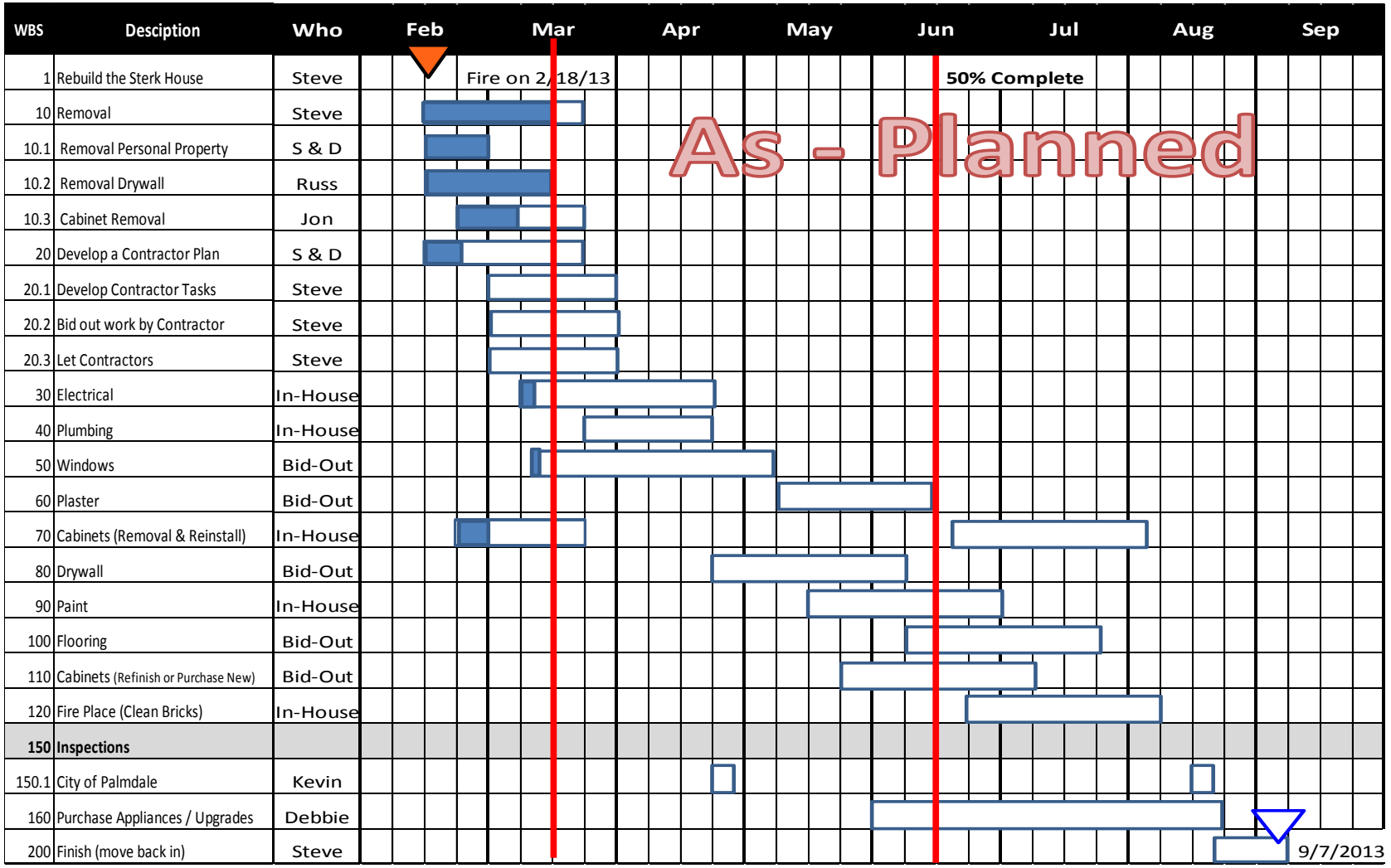
Source: GAO.

NASA's 12 Step Process

- Step #1 - Receive the Customer Request and Understand the Project.
  - "This was my home not a Govt. Project".
    - Foot Note: I originally built my home (1988) from my high school senior project drafting plans that were stuffed away since 1976.
- Step #2 - Build the WBS.
  - See Slide #6
- Step #3 - Participate in the Tech. Development.
  - Once in a lifetime to upgrade new technology e.g. Led Lighting, HDMI
- Step #4 - Develop the Ground Rules and Assumptions. (see Lessons Learned)
- Step #5 – Select the Cost Estimating Methodology.

Develop a Cost Estimation Plan

- As Planned



The Cost Estimation Process

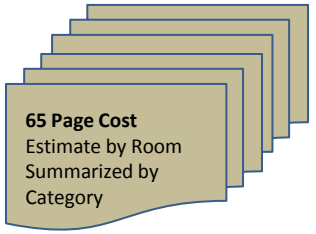
- Step 6 – Select and Build a Cost Model
  - ((Steve's | Schedule | Scientific)) Wild Ass Guess Algorithm (SWAGA)

WBS	Desciption	Who	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
10.1	Removal Personal Property	S & D								
10.2	Removal Drywall	Russ								
10.3	Cabinet Removal	Jon								

As - Planned

WBS	Desciption	Start	End	Est	Labor	Rate	# of Day	Mat'l
10.1	Removal Personal Property	2/19/13	3/5/13	$ 1,100.00	$ 1,000.00	100	10	**$ 100.00**
10.2	Removal Drywall	2/19/13	3/15/13	$ 2,185.18	$ 2,000.00	100	20	**$ 185.18**
10.3	Cabinet Removal	2/19/13	3/26/13	$ 2,000.00	$ 2,000.00	100	20	$ -

  - Insurance Adjuster came with Laser Meter Reader and Casualty Insurance Software
    - He gave me a 65 page detailed cost estimate by room and summary levels by sub element. (Bottoms-up)
      - Loss of Use
      - Construction
      - Contents (Replacement Value)
  - Estimates were then compared to the SWAGA
  - Each WBS element needed three cost estimates from Licensed Sub-Contractors



Original Contract / Change Order

1. My number one goal “being a cost professional” was to eliminate all cost over-runs and to keep change orders out of the estimate-to-completion (ETC).

To keep “change orders” at a minimum

2. Home owners discovers obstacles that deviated from the original plan.

3. The customer or project team are inefficient or incapable of completing their required deliverables within budget, and additional money, time, or resources must be added to the project

4. During the course of the project, additional features, upgrades were requested.

5. The contractor looked for work items to add to the original scope of work at a later time in order to achieve the lowest possible base bid price, but then add work items and fee back on once the contractor has been hired for the work. This is an exploitative practice.

The Cost Estimation Process

- Step 7 – Gather and Normalize the Data
- Licensed Contractors were given an electronic copy of the blue prints “the Requirements”.
  - 90% of the Contractors wanted a site visit
  - All the Contractors seemed to double check measurements / requirements.
  - Sized up the job for “Complexity Factor” and applied their cost estimates algorithm and submitted the bid.
  - Construction Estimates included Labor & Material (Profit/Fee was built-in).
    - The assumed cost estimation method was;
      - Analogy Method
      - Parametric Method
      - Engineering Build-up Method
      - Phases (Phase A, Phase B, Phase C, Phase D, Phase E)
- Determine which WBS items on the Gantt Chart to “Bid-out” or perform “In-House”.
- Step 8 - Develop the “Point Estimate”.
- Step 8a – Develop the “Schedule and Milestones”.


Material “on-site the night before
Safety / Stand-up Meeting
occurred at 6:00 Am

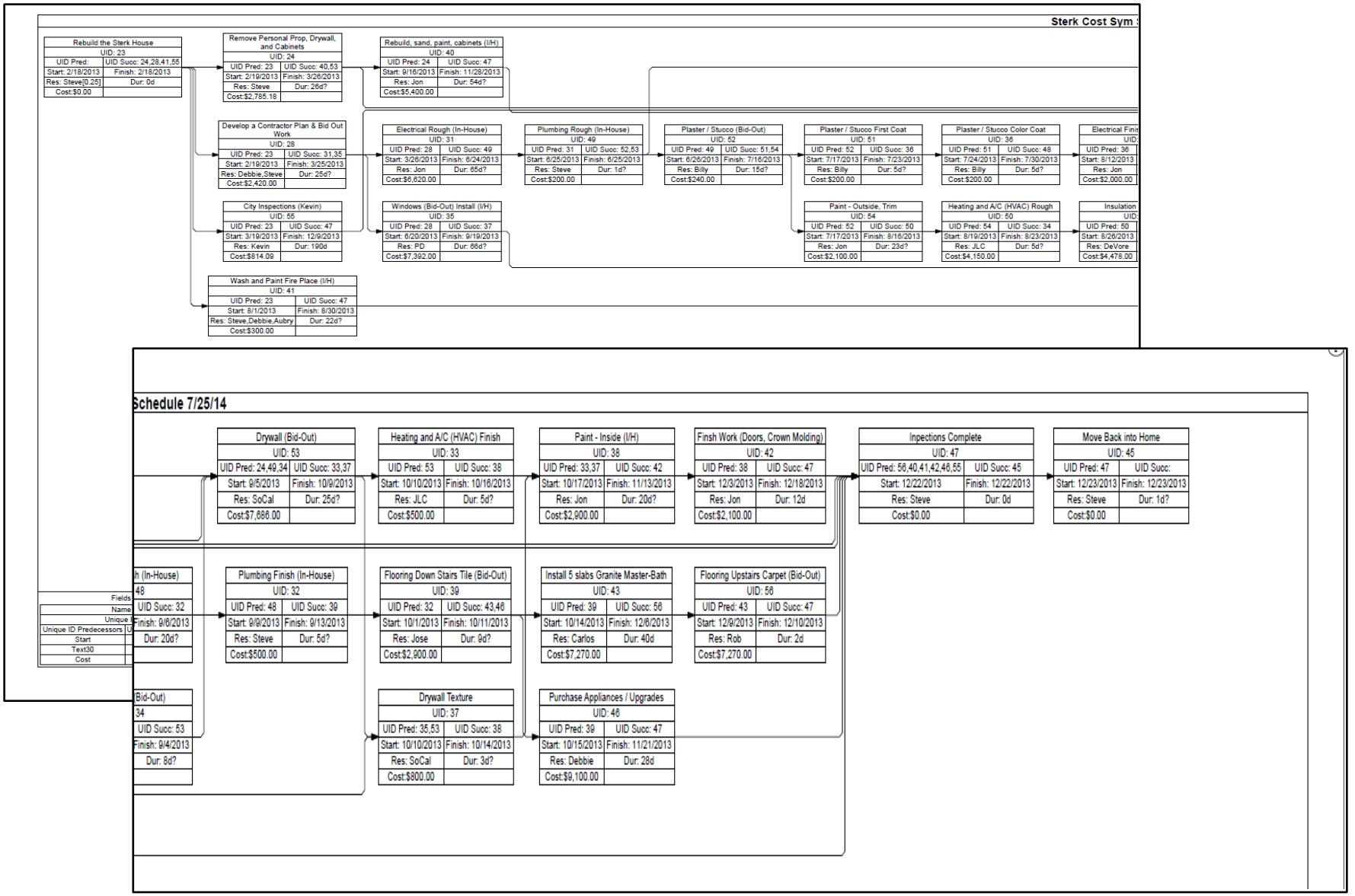
Work-in-Progress

- Step 9 – Develop the Cost Risk (See JCL)
- Step 10 – Document the Estimate
- Step 11 – Present the Cost Estimate
- Step 12 – Updating the Cost Estimate on a regularly basis was a the Golden Key !
  - This allowed for:
    1. Unidentified Future Expenses / Change Orders
    2. Upgrades and Add-ons
- There are 3 grades to home construction
    1. Basic – Good
    2. Standard - Better
    3. High-End - Best

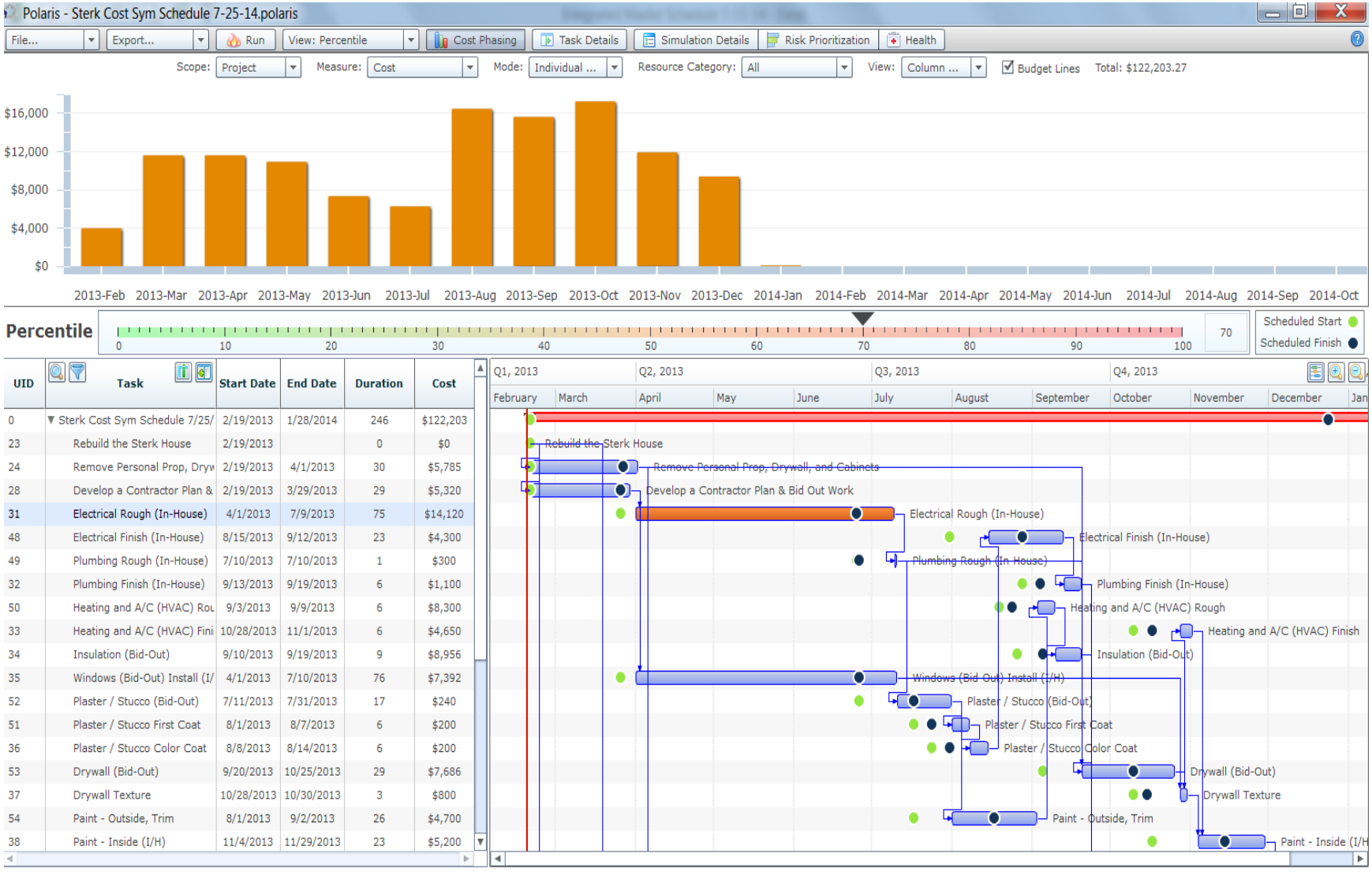
❖ Costs - Have to weigh the difference (3 Grades) and is scalable to the features that go into the Home.

❖ Schedule - Construction project scheduling can vary depending on the availability of supplies, weather, labor, and the progress of tasks being completed on time. These are also estimates based on experience and generalities.

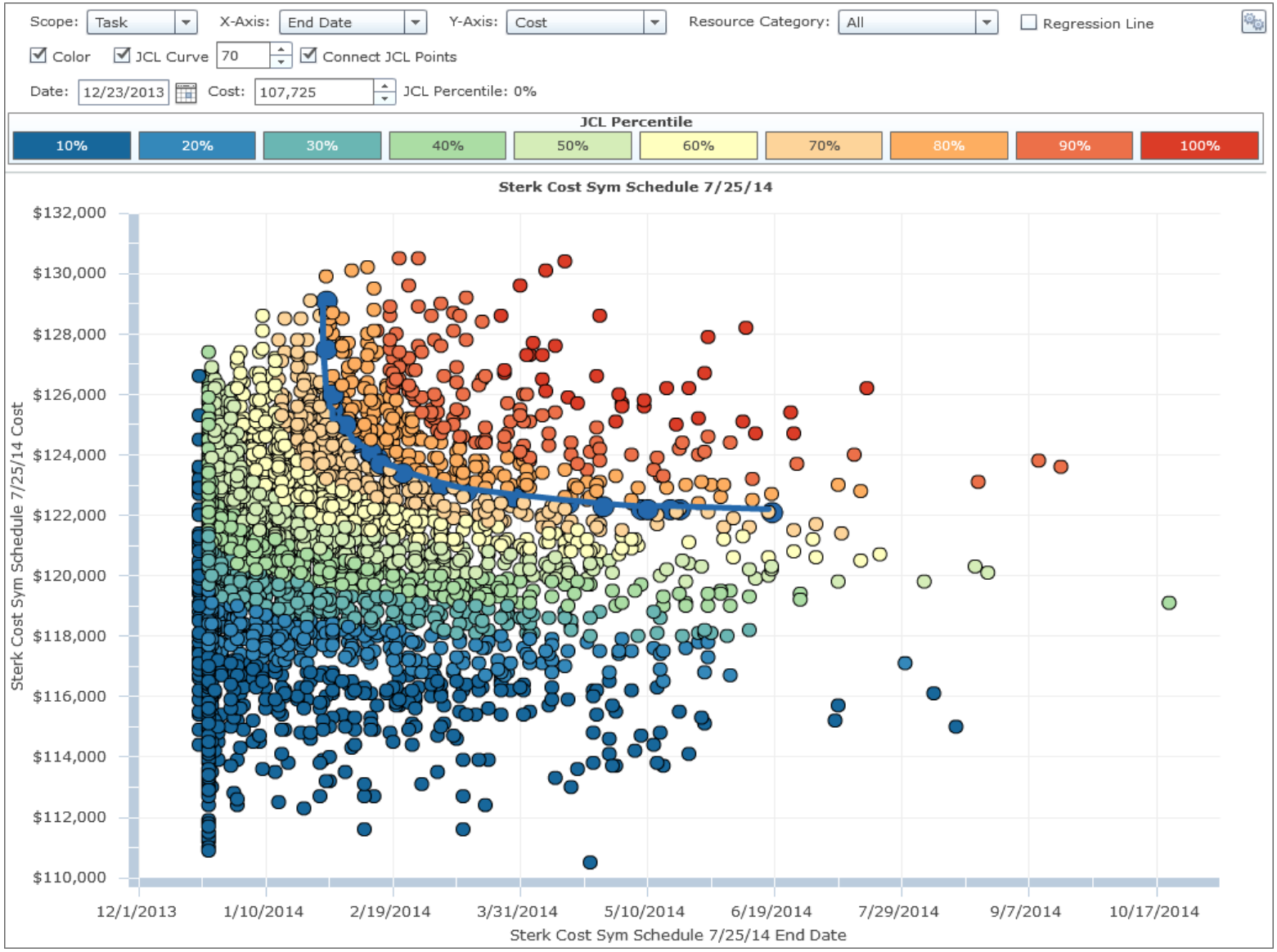
M/S Project Schedule



Risk Adjusted Cost & Schedule



JCL Scatter Plot

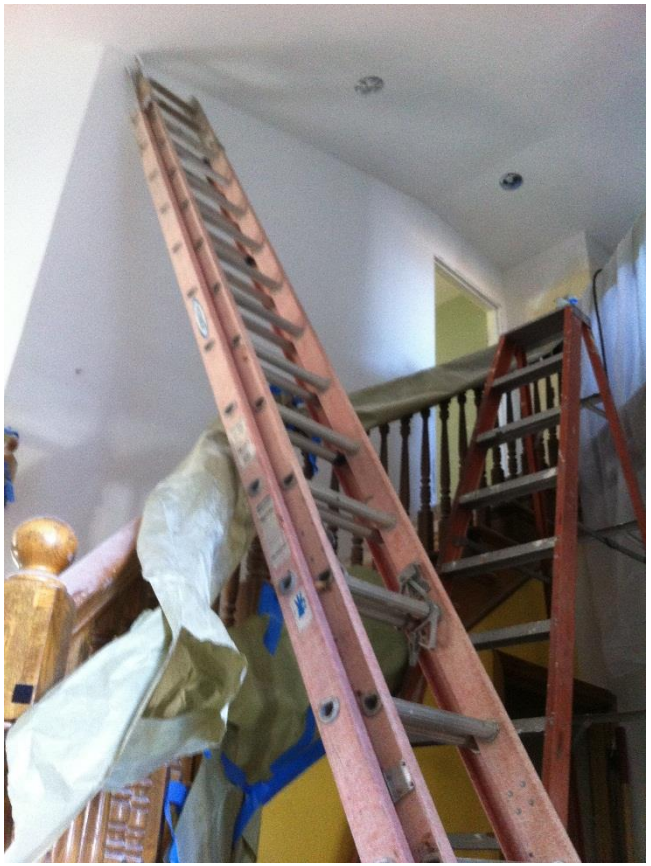


Number of Test / Quality Control

- **Number of test was held to a minimum.**
- Gas Pressure Test
- Requirement has to sustain 7 lbs. PSI over 48 hours.
- Ambient temperature through-out the day changes the reading.
- Higher outside temperature will reduce the pressure.

Work-in-Progress

- Endorse new technology !
  - Paint sprayer versus paint brush & roller
  - Prep time is longer but saves time in the long run with higher quality



Work-in-Progress

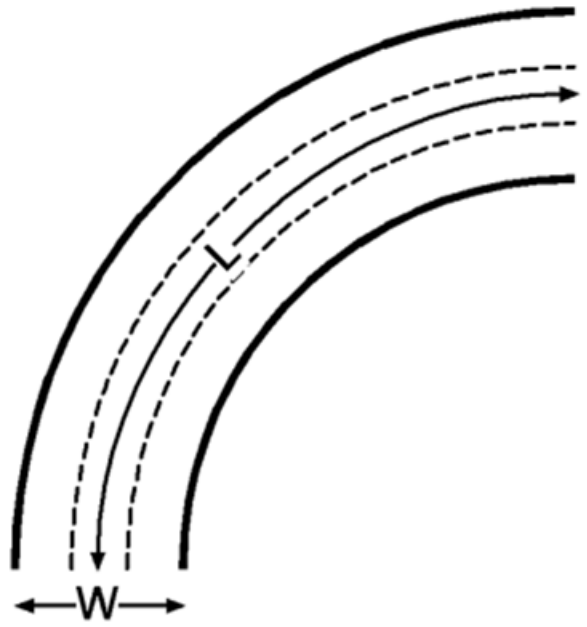
- All new windows were installed with double pain high “R-Value” energy star rating.

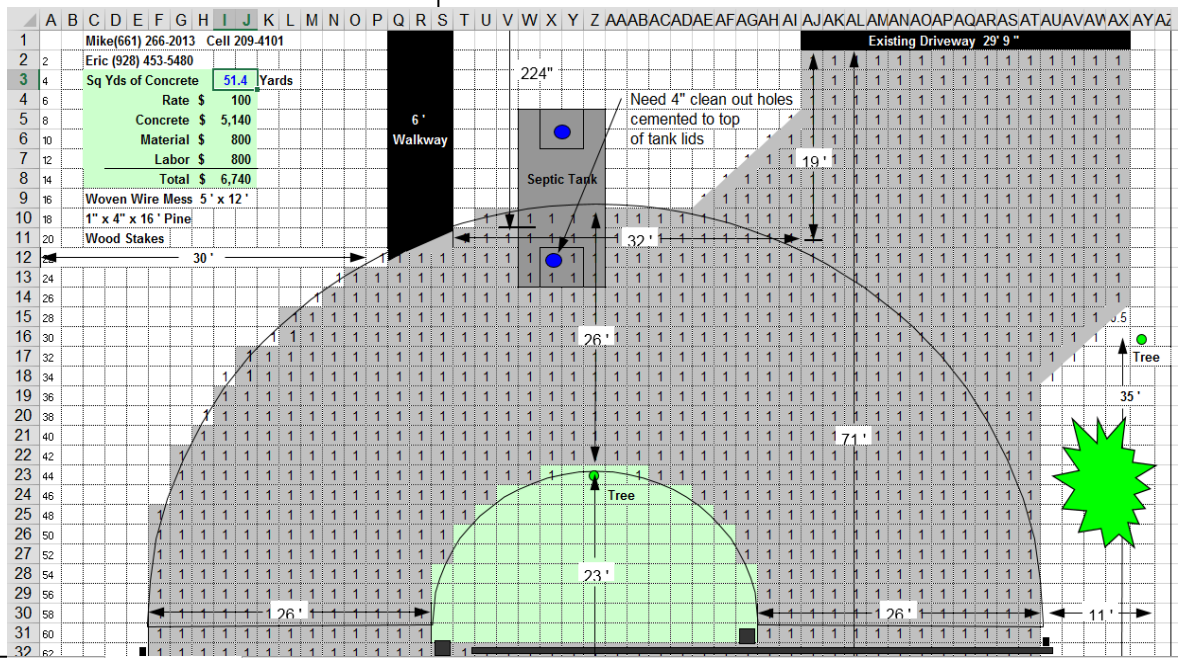
Parametric Construction Estimating

- How much cement needs to be procured for a circular driveway 4 inches thick with mess wire and rebar ?

A note about measuring areas of roadways with curves

When determining the area of a roadway with a curve it is important that the length be measured along the centerline of the road. By doing this the area is simply the length of the arc along the centerline times the width.





- Answer - 27 Yards

Lessons Learned

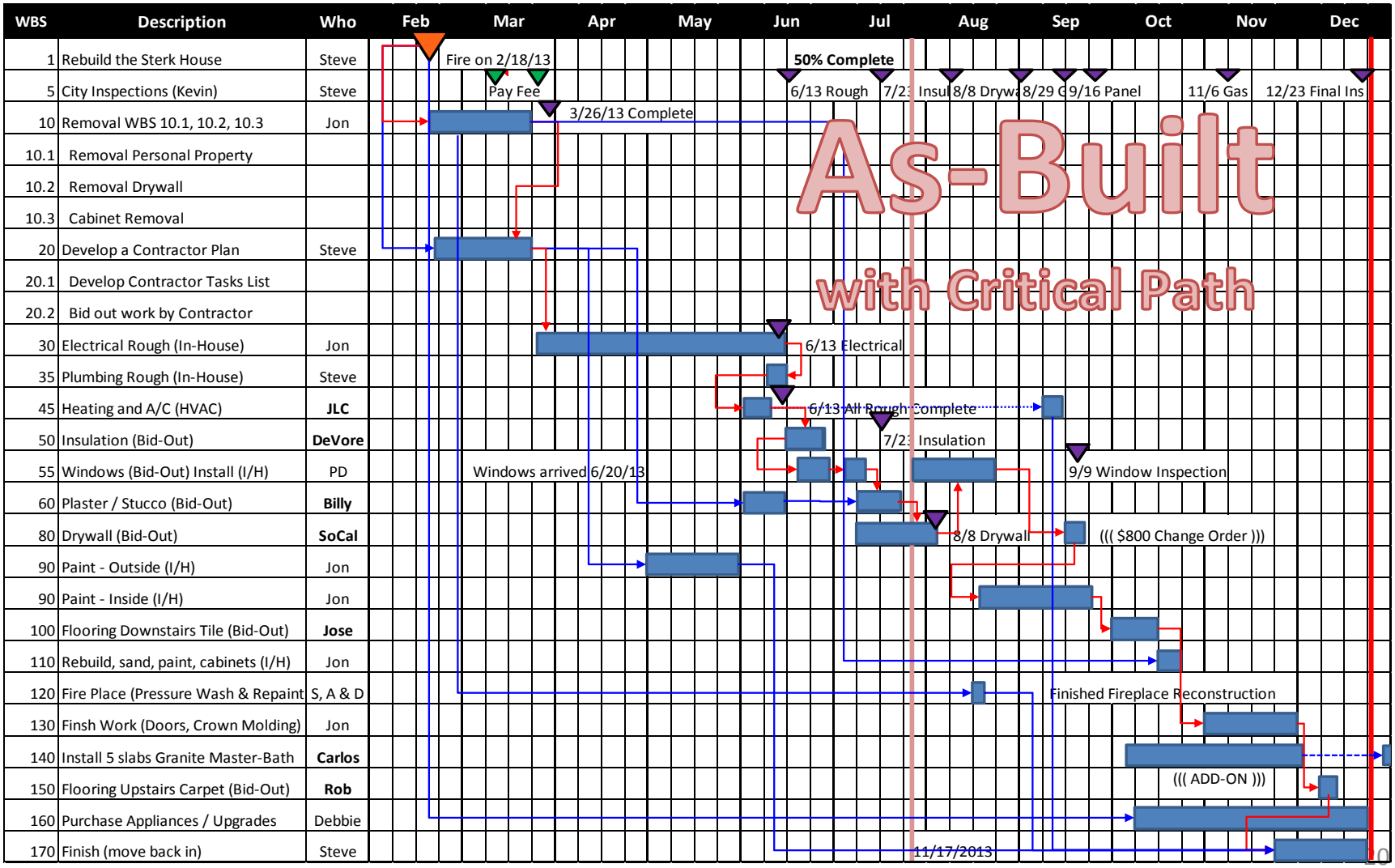
- Lesson 1 – Internal Communication ~ This was my home, not a government project. There is a certain “work culture” that goes on within the work environment. About half-way through the project it came clear that my own family members did not know what a critical path is . . . nor did they understand the culture at work. As the Project Manager it was my fault.

- Lesson 2 – External Communication ~ For the activities that were subcontracted out, the Foreman came inside the house and created a material list. The list of material was purchased and was brought with them or as in the case of the drywall, was dropped at the construction site prior to the “Hangers”. Hangers is a slang word used in the construction industry for a “specialized” group of workers. As a side note; in the Drywall Industry have several slang words called: Stackers, Hangers, Tapers, Spacklers, and Finishers. Each group is a specialized group of workers that only do that specific work.

- Lesson 3 – Know your Contractor and perform references often ~ We hired our Granite guy, “Carlos” that we used to upgrade the kitchen several years earlier. In this case we went with a single source bid, based on a good experience several years ago. The problem we got into was (unknowing to us) was Carlos had moved his company to a higher clientele area, near Beverly Hills, resulting in a 4 week delay with no incentive in finish “on-time” or ahead-of-schedule.

Schedule Derived Cost Estimation

- As Built



Samples of Construction Software



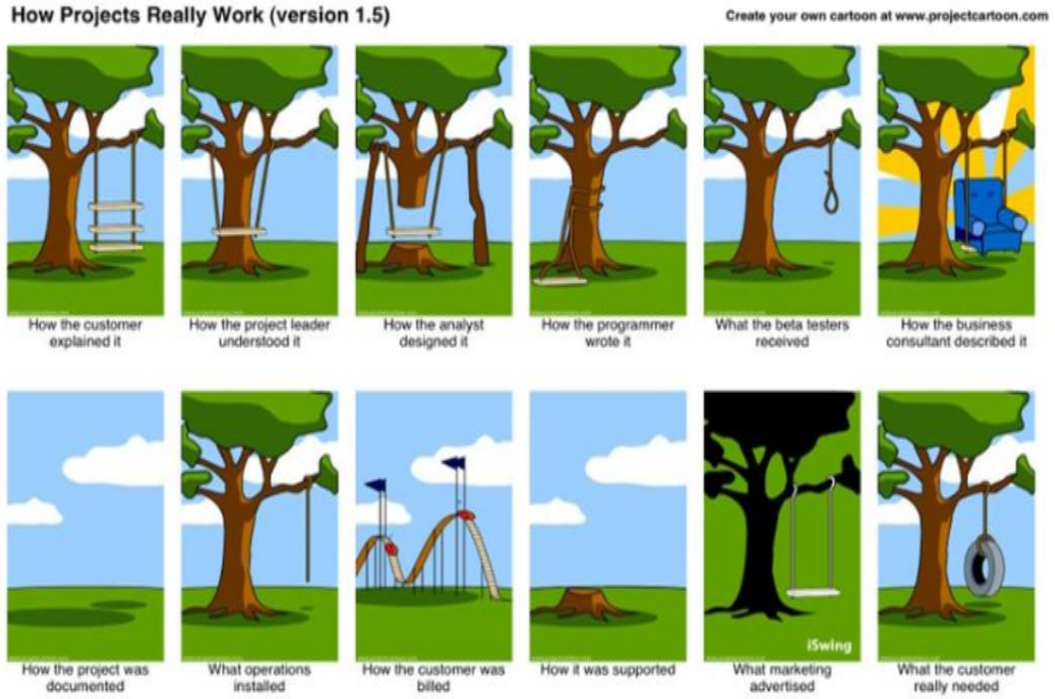


Conclusion
NASA vs. Construction

- Both Industries have Parametric Data Bases.
  - Parametric Construction Models are updated more often
    - By Region, By Material, By Labor – Cost Elements.
- NASA and GAO use a 12 Step Cost Estimation Process, where-as Construction Process are indigenous to the Owner / is held accountable.
- As with most private construction projects the designer, architect or engineer puts the customers vision on paper for review and approval by the customer before anything is sent out to bid. A general contractor is then hired by bid and quite possibly by reputation to oversee the project. He of course in order to complete his bid, has already sent the plans to his various sub-contractors for bid on the portions that they will be responsible for. In many cases the general contractor will be responsible for some portion of the construction work to be provided to the customer.

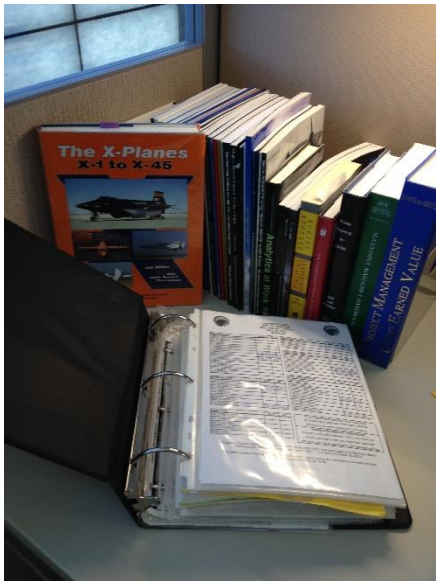
Conclusion “Continued”

- Communication – is essential for both parties
  - Sometimes during the process we lose focus or intent of what the customer requested in the original plan.
  - We must be able to speak each other’s language



Conclusion "Continued"

- Critical Path
  - Ensure all Team Members know what the Critical Path is . . .
- Costs
  - Gather up //signed// Contracts
  - Update the ETC & EAC often – watch the bottom line.
- Earned Value for this project was somewhere near;
  - Schedule Performance Index (SPI) = .81
  - Cost Performance Index (CPI) = 1.52
- I developed a methodology to capture all the cost, i.e. Historical Data Base.
  - Every receipt was captured and filed
  - I never had the time to go back and add up all the cost to get a exact amount.
- Total Funding minus expenses was the cost.



Before and After

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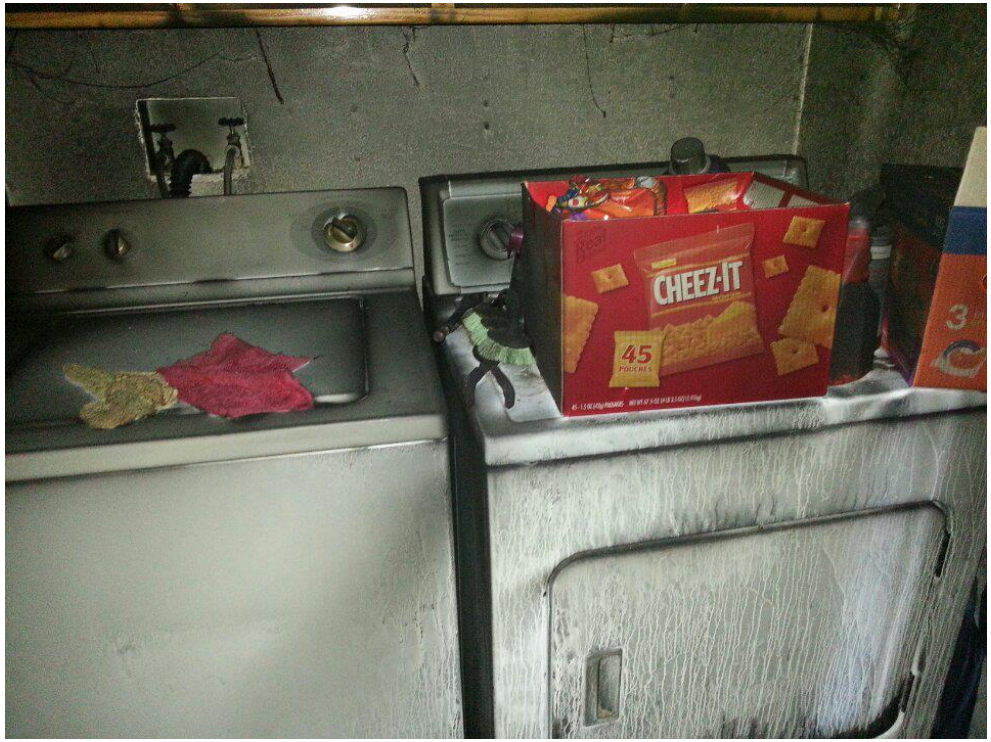

Final Inspection

INSPECTION CARD
CITY OF PALMDALE
BUILDING AND SAFETY
(661) 267-5353
B13-00239

BUILDING INSP.		DATE	BY
100	FTNG/HARDWARE/SETBACKS		
101	MASONRY		
102	SLAB		
103	ROOF SHEATHING		
104	PRE-WRAP		
105	FRAMING		
106	INSULATION		
107	DRYWALL		
108	FIREWALL LAYERS		
109	EXT. LATH		
110	FIREPLACE		
111	T-BAR CEILING		
112	OTHER		

PLUMBING INSP.		DATE	BY
200	UNDERGROUND PLUMBING		
201	ROUGH PLUMBING		
202	GAS TEST		
203	SEWER		
204	SEPTIC SYSTEM		
205	SEWER CAP		
206	OTHER		

POOL INSP.		DATE	BY
500	PRE-GUNITE		
501	PRE-DECK		
502	GAS TEST		
503	PRE-PLASTER		
504	FINAL		

MECHANICAL INSP.		DATE	BY
300	ROUGH MECH.		
301	DAMPERS		
302	OTHER		

ELECTRICAL INSP.		DATE	BY
400	GROUNDING ELECT.		
401	U/G CONDUIT		
402	ROUGH CONDUIT		
403	ROUGH WIRING		
404	PANEL MAKE-UP		
405	OTHER		

FINAL INSPECTIONS*		DATE	BY
900	ENERGY		
901	SECURITY		
902	ACCESSIBILITY		
903	SP. INSP. FINAL RPTS		
904	ELECTRICAL		
905	MECHANICAL		
906	PLUMBING		
907	BUILDING		
908	PERMIT FINAL		

*Final inspections do not allow use or occupancy of a structure. A certificate of Occupancy shall be issued prior to use or occupancy of a structure.

INSPECTION REQUEST PROCEDURE

Inspections requested between 7:00 a.m. and 8:00 a.m. will be scheduled for that day. Inspections requested after 8:00 a.m. will be scheduled for the following work day.

Occupancy releases may be required from the following agencies prior to occupancy approval by Building & Safety
Planning Dept. 267-5200 - Engineering Dept 267-5272 - L.A. County Fire Dept. 949-6319

If this permit involves a Business, contact the City of Palmdale Business License office to determine if a license is required.
Business License Office 267-5434


Questions

Back-up / References Slides

Sterk, Steve A. (AFRC-C)

From: Kevin Kent <KKent@cityofpalmdale.org>
Sent: Wednesday, July 23, 2014 5:26 PM
To: Sterk, Steve A. (AFRC-C)
Subject: Nasa Project Estimating Power Point

Hi Steve,

I received your presentation on my desk this afternoon. Private, Public/Government costing and bidding procedures are quite different. The NASA and GAO 12 step models are a tribute to the amount of documentation generated versus the actual accomplishment of a task or scope of work to be provided.

As with most private construction projects the designer, architect or engineer puts the customers vision on paper for review and approval by the customer before anything is sent out to bid. A general contractor is then hired by bid and quite possibly by reputation to oversee the project. He of course in order to complete his bid, has already sent the plans to his various sub-contractors for bid on the portions that they will be responsible for. In many cases the general contractor will be responsible for some portion of the construction work to be provided to the customer.

Sometimes during the process we lose focus or intent of what the customer requested in the original plan. The level of quality of materials and craftsmanship varies from good, better, and best. Unless the plans specify the exact type, size, grade, color, finish, manufacturer etc., prepare to get the least expensive item to satisfy the contract.

Project cost overruns are due to changes from the original plan after the bid has been accepted. If the cost of materials, labor, supplies, increases or the bid was underestimated after the bid has been accepted, this should not a reason for a change order. If the contractor benefits from decreases in his costs during the project, does the customer receive a refund?

Construction project scheduling can vary depending on the availability of supplies, weather, labor, and the progress of tasks being completed on time. These are also estimates based on experience and generalities.

Bringing estimating under control, streamlining processes, reducing the number of changes and providing all involved with accurate and current information that is readily accessible all are just a few of the efficiencies in the system. Communication with all people involved in the project is the key for streamlining any process.

Well, these are the ramblings of a slightly overworked inspector. If this has helped or if you need any additional information, let me know.

Thank You,

Kevin Kent
Building Inspector
City of Palmdale

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